



ASML

"Integration and automatic testing: Don't bet on one horse!"

Content

- Introduction
- ASML
 - Yieldstar in ASML
- Automatic testing
 - Nunit
 - Replay sets
 - Twist
 - Automatic UI tests
- Integration of these automatic tests

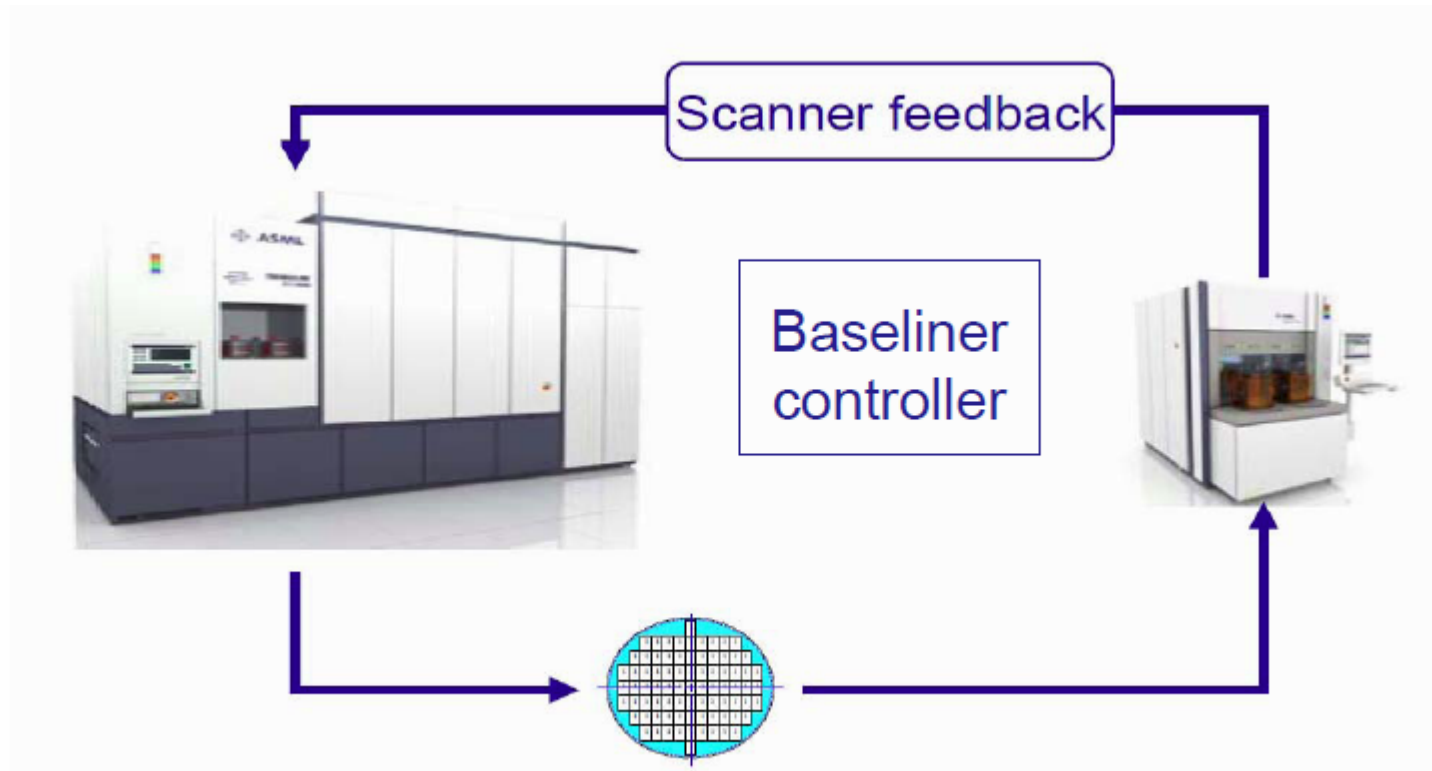
Who Am I: Johan Meuwissen

- Education: TU/e Technische Informatica
- Work experience
 - Philips PDSL/Research (content identification)
 - TV business (NXP/Philips Bruges)
 - Since May 2011: ASML
- Integration/Test Experience
 - Lot of integration
 - Not much test 😊
- Hobbies



ASML

- Twinscan
 - 80% of all chips are produced by an ASML machine!



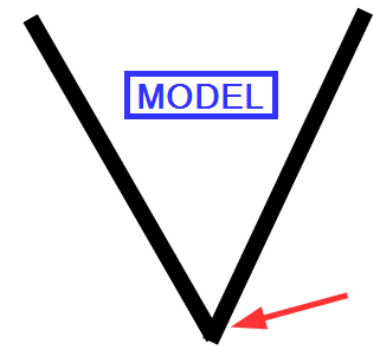
Yieldstar in ASML

- Metrology tool
 - Improve Litho performance
- Scrum team structure (Yieldstar SW)
 - 6 Yieldstar development teams
 - C# visual studio 2010
 - Test automation team
 - STI Yieldstar



Automatic Testing: NUnit

- Unit tests adapted and Extended by Teams
 - Executed several times a day by Integration (and rarely fail)
 - 450 → 625 tests in 1 year

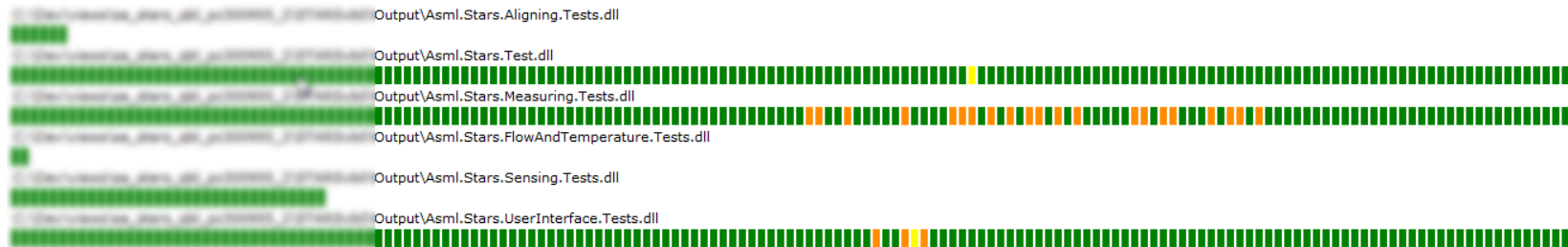


NUnit Test Results

Summary

Assemblies tested: 625
Tests executed: 3238
Passes: 3238
Fails: 0
Ignored: 51

Extended Summary:



Assembly Test Details:

[Expand assemblies](#) | [Collapse assemblies](#) | [Expand tests](#) | [Collapse tests](#) | [Expand all](#) | [Collapse all](#)
✓▶ [Output\Asml.Stars.Aligning.Tests.dll](#)
✓▶ [Output\Asml.Stars.Aligning.Tests.dll](#)

Automatic Testing: Nunit – Failing test

Dashboard > local > sacdbuild_qbl_CD_2012_int CD Integration > 2012-03-11 22:00:03 (Failed) Version : 1.6.79

Latest
Next
Previous

Build Report
View Build Log
NCover Report
MSBuild Report
NUnit Timing
NUnit Details
NUnit Alternative Details
Failed NUnit Tests

Recent Builds

- 2012-03-12 22:00:00 (26)
- 2012-03-11 22:00:03 (Failed)
- 2012-03-10 22:00:42 (Failed)
- 2012-03-09 22:00:00 (Failed)
- 2012-03-08 22:00:54 (Failed)
- 2012-03-07 22:00:25 (Failed)
- 2012-03-06 22:00:00 (25)
- 2012-03-05 22:37:18 (24)
- 2012-03-04 23:37:13 (Failed)
- 2012-03-03 22:00:00 (Failed)

Show All

▼ Asml.Stars.Measuring.Tests.dll - 5 tests (3 passed, 2 failed, 0 didn't run)

Test Fixture	Results	Passed: (3/5)
▼ RobustRecipeCalculatorTest	<div><div></div><div></div><div></div><div></div><div></div></div>	
❌ CalculateOneWindowWithReconstructions [CDIntegration]	Expected: 1 But was: 0 at Asml.Stars.Measuring.CD.RobustRecipe.Test.RobustRecipeCalculatorTest.CalculateOneWindowWithReconstructions() in Test\RobustRecipeCalculatorTest.cs:line 486	
❌ TestScoresOneWindow [CDIntegration]	Expected: 11.621060437978059d +/- 0.00010000000000000001d But was: 0.0d at Asml.Stars.Measuring.CD.RobustRecipe.Test.RobustRecipeCalculatorTest.TestScoresOneWindow() in Test\RobustRecipeCalculatorTest.cs:line 284	
✅ MissingMeasurementsInDataset [CDIntegration]		
✅ TestScoresKPICalculatorApplication [CDIntegration]		
✅ TestScoresPatternMatcher [CDIntegration]		

Automatic Testing: Replays

- Playback of recorded Yieldstar data on stand alone PC
- Compare of the output data with reference data

The screenshot displays the Yieldstar software interface. At the top, a status bar shows 'Control State: Online / Remote', 'Comm. State: Enabled / Communicating', 'Date: 3/6/2012', 'Time: 12:42:26 PM', 'Release: 2.2.0.c', and 'Machine nr: 0000'. Below this is a menu bar with 'File' and 'Tools'. The main window has tabs for 'Wafer Handler', 'Measurement setup', 'Progress Monitor', and 'History Log'. The 'Progress Monitor' tab is active, showing a tree view of the job structure: 'ControlJob1' (Executing), 'replay' (Processing), 'replay\ReplayRecipeS100', and 'Wafers' (a.01: In Process, a.02: Needs Processing). Below the tree are buttons for 'Start', 'Stop', 'Pause', 'Resume', and 'Abort'. A section for 'Control job functions' includes a checkbox for 'Enqueue Completed Control Jobs Again' and buttons for 'De-select', 'Head of Queue', and 'PJ pool'. On the right, the 'Live View' tab is active, showing details for the 'Control Job' (Name: ControlJob1, Nr. of Process Jobs: 1, Nr. of wafers to measure: 2), 'Process Job' (Name: replay, Recipe: replay\ReplayRecipeS100, Nr. of wafers: 2), and 'Wafer' (Name: a.01, Scheme: , Nr. of measurements: 104, Nr. of accepted: 0). A large black 'V' shape is drawn over the right side of the interface, with a red arrow pointing to its right leg. A blue box with the word 'MODEL' is positioned near the top of the 'V'.

Id	State
ControlJob1	Executing
replay	Processing
replay\ReplayRecipeS100	
Wafers	
a.01	In Process
a.02	Needs Processing

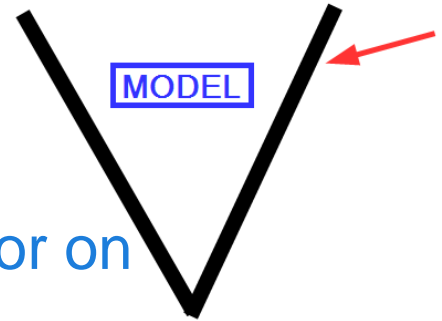
Control Job
Name: ControlJob1
Nr. of Process Jobs: 1
Nr. of wafers to measure: 2

Process Job
Name: replay
Recipe: replay\ReplayRecipeS100
Nr. of wafers: 2

Wafer
Name: a.01
Scheme:
Nr. of measurements: 104
Nr. of accepted: 0



Automatic Testing: Twist (ASML internal)



- Communication to Yieldstar software (simulation or on tool) via SECS interface
 - Intelligent data compare
 - TWIST is meant for system level testing + interoperability testing. Testing is done using Data Driven Test techniques.

Test results summary

Result	#	%	Indicator
Passed	2	100	<div><div></div></div>
Failed	0	0	
Skipped	0	0	
Error	0	0	
Other	0	0	
Total	2	100	

Found 4 errors and 17 warnings in ER event log while executing tests.

Testcase results

ID	Start	End	Name	Result	Failed on	Root error
1	2012-03-06 01:36:34	2012-03-06 01:36:34	demo/TT_MachineConfig - TV_MachineConfig	Passed		
2	2012-03-06 01:36:36	2012-03-06 01:41:23	TT_SECS_Reporting_All_S100.xml - TV_SECS_Reporting_All_S100	Passed		



Automatic Testing: Twist

- Detailed reporting (DEMO!)

Step Nr	Start	End	SUT	Command	Result	Context																									
2.1	2012-03-06 01:36:36	2012-03-06 01:36:36	yieldstar	Unused entries detected in TstVector	Skipped	<ul style="list-style-type: none">The following vector IDs are unused: 110																									
2.2	2012-03-06 01:36:36	2012-03-06 01:37:07	yieldstar	[0.1] Start Communication - Setup SECS communication and check ControlState	Passed	<ul style="list-style-type: none">rptd_as_enabled.rptdrptd_as_defined.rptdYieldStarSecsHost_A_NS300955_5000.logGeneric.SECs.CommunicationRequestInteractor : Storing 'SECSConnection' as 'YieldStarConnection' for later retrieval.Generic.BasicTstValidator : <table><tr><th colspan="4">Result comparison</th></tr><tr><th>Keyword</th><th>Expected</th><th>Actual</th><th>Compare</th></tr><tr><td>COMMACK</td><td>0</td><td>0</td><td>PASS</td></tr><tr><td>Control State</td><td>1</td><td>1</td><td>PASS</td></tr></table>	Result comparison				Keyword	Expected	Actual	Compare	COMMACK	0	0	PASS	Control State	1	1	PASS									
Result comparison																															
Keyword	Expected	Actual	Compare																												
COMMACK	0	0	PASS																												
Control State	1	1	PASS																												
2.3	2012-03-06 01:37:07	2012-03-06 01:37:37	yieldstar	[100.1] Enable default events: - Default event reports	Passed	<ul style="list-style-type: none">Generic.SECs.SubscribeReportDataExpander : Retrieving input value from stored key 'YieldStarConnection' as 'SECSConnection'.Generic.SECs.SubscribeReportDataExpander : Using report definition 'SECS\Report_Definitions\RPT_Default_Events.rptd'.Generic.SECs.SubscribeReportInteractor : Deleted all previous reports.Generic.SECs.SubscribeReportInteractor : Disabled all events.Generic.SECs.SubscribeReportInteractor : WARNING: multiple reports are defined at once; validation of a single report is not possible!rptd_as_defined.rptdGeneric.SECs.SubscribeReportInteractor : Enabled 6 report(s).rptd_as_linked.rptdGeneric.SECs.SubscribeReportInteractor : Linked 6 report(s).rptd_as_enabled.rptdGeneric.SECs.SubscribeReportInteractor : Enabled 7 event(s).Generic.BasicTstValidator : <table><tr><th colspan="4">Result comparison</th></tr><tr><th>Keyword</th><th>Expected</th><th>Actual</th><th>Compare</th></tr><tr><td rowspan="4">ValidateEnabledEvents</td><td>DR_Acknowledge</td><td>0</td><td>DR_Acknowledge</td><td>0</td></tr><tr><td>EER_Acknowledge</td><td>0</td><td>EER_Acknowledge</td><td>0</td></tr><tr><td>LER_Acknowledge</td><td>0</td><td>LER_Acknowledge</td><td>0</td></tr><tr><td></td><td></td><td></td><td>PASS</td></tr></table> <ul style="list-style-type: none">Found 1 warning in ER event log while executing test step.	Result comparison				Keyword	Expected	Actual	Compare	ValidateEnabledEvents	DR_Acknowledge	0	DR_Acknowledge	0	EER_Acknowledge	0	EER_Acknowledge	0	LER_Acknowledge	0	LER_Acknowledge	0				PASS
Result comparison																															
Keyword	Expected	Actual	Compare																												
ValidateEnabledEvents	DR_Acknowledge	0	DR_Acknowledge	0																											
	EER_Acknowledge	0	EER_Acknowledge	0																											
	LER_Acknowledge	0	LER_Acknowledge	0																											
				PASS																											



Automatic Testing: UI Tests

MODEL

- Using Visual Studio 2010 Premium (Coded UI Test)
 - 200 page test spec now for 75% automated
 - UI team

[Latest](#)
[Next](#)
[Previous](#)

[Build Report](#)
[View Build Log](#)
[NCover Mgmt. Report](#)
[NCover Full Report](#)
[MSBuild Report](#)
[NUnit Details](#)
[NUnit Alternative Details](#)
[Failed NUnit Tests](#)
[MSTest Report](#)

BUILD FAILED

Project: sauibuild_qbl_UI_2012_1_int AutomatedUITest
Date of build: 2012-03-14 06:55:24
Running time: 01:00:48
Integration Request: Build (ForceBuild) triggered from AutomatedUITest

Modifications since last build (0)

Tests run: 56 Failures: 9 Inconclusive: 0

F StartWavelengthAdvisor	Assert.AreEqual failed. Expected:<True>. Actual:<False>. Test method Asml.Stars.UserInterface.AutomatedUITests.CDProfileEditor.GeneralTest.AssertNewConver
F AssertNewConventionaProfileIs2Dimensional	Microsoft.VisualStudio.TestTools.UITest.Extension.UITestControlNotFoundException: The playback failed properties. Additional Details: TechnologyName: 'MSAA' ControlType: 'MenuItem' Name: 'Conventional (System.Runtime.InteropServices.COMException: Error HRESULT E_FAIL has been returned from a call to
F AssertCancelOpeningProfile	Test method Asml.Stars.UserInterface.AutomatedUITests.CDProfileEditor.GeneralTest.AssertCancelOper Microsoft.VisualStudio.TestTools.UITest.Extension.UITestControlNotFoundException: The playback failed properties. Additional Details: TechnologyName: 'MSAA' ControlType: 'MenuItem' Name: 'Conventional (System.Runtime.InteropServices.COMException: Error HRESULT E_FAIL has been returned from a call to
F CheckDefaultApertureConventional	Test method Asml.Stars.UserInterface.AutomatedUITests.CDProfileEditor.SettingsViewTest.CheckDefaul Microsoft.VisualStudio.TestTools.UITest.Extension.UITestControlNotFoundException: The playback failed properties. Additional Details: TechnologyName: 'MSAA' ControlType: 'MenuItem' Name: 'Conventional (System.Runtime.InteropServices.COMException: Error HRESULT E_FAIL has been returned from a call to
F CheckDefaultApertureFeedForward	Test method Asml.Stars.UserInterface.AutomatedUITests.CDProfileEditor.SettingsViewTest.CheckDefaul Microsoft.VisualStudio.TestTools.UITest.Extension.UITestControlNotFoundException: The playback failed properties. Additional Details: TechnologyName: 'MSAA' ControlType: 'MenuItem' Name: 'Feed forward (System.Runtime.InteropServices.COMException: Error HRESULT E_FAIL has been returned from a call to

Recent Builds

2012-03-15 07:03:44 (Failed)
2012-03-14 06:55:24 (Failed)
2012-03-13 07:00:43 (Failed)
2012-03-12 06:56:52 (Failed)
2012-03-09 07:00:50 (Failed)
2012-03-08 06:59:29 (Failed)
2012-03-07 06:11:19 (Failed)
2012-03-06 06:45:59 (Failed)
2012-03-05 06:52:39 (5)
2012-03-02 05:30:27 (Failed)

Integration of all these test techniques: Cruisecontrol.NET

CruiseControl.NET
CONTINUOUS INTEGRATION SERVER

Dashboard > buildPC

Server Report

Project Name	Last Build Status	Last Build Time	Next Build Time	Last Build Label	CCNet Status	Activity
sa_stars_qbl_2_int_AutoUITest	Failure	2012-03-15 02:31:15	2012-03-16 02:30:00	50	Running	Sleeping
sa_stars_qbl_2_int_ContinuousSTIBuild	Success	2012-03-15 22:09:34	2012-03-15 22:27:35	33	Running	Pending
sa_stars_qbl_2_int_Coverage Build	Success	2012-03-15 03:30:00	2012-03-16 03:30:00	179	Running	Sleeping
sa_stars_qbl_2_int_CTROBuild	Failure	2012-03-15 07:54:19	2012-03-16 05:03:00	1	Running	Sleeping
sa_stars_qbl_2_int_Nightly Build	Exception	2012-03-14 22:20:20	2012-03-15 22:20:00	124	Running	Building

2012-03-15 22:28:38 Executing MSBuild :BuildFile: Asml.Stars.msbuild

2012-03-15 23:17:16 Waiting for 'Event ProcessJobReportsAvailable, Event 1003, Event 1004, Event 1007' ...

2012-03-15 23:17:16 Done (EventReport - Optional events)

2012-03-15 23:17:16 Waiting for 'Event ProcessJobReportsAvailable, Event 1003, Event 1004, Event 1007' ...

2012-03-15 23:17:16 Done (EventReport - Optional events)

2012-03-15 23:17:16 Waiting for 'Event ProcessJobReportsAvailable, Event 1003, Event 1004, Event 1007' ...

2012-03-15 23:17:16 Done (EventReport - Optional events)

2012-03-15 23:17:16 Waiting for 'Event ProcessJobReportsAvailable, Event 1003, Event 1004, Event 1007' ...

2012-03-15 23:17:16 Done (EventReport - Optional events)

- Scheduling



Cruisecontrol.NET dashboard

The screenshot shows the CruiseControl.NET dashboard. At the top, there's a green header with the logo and text "CruiseControl.NET CONTINUOUS INTEGRATION SERVER". Below this is a navigation bar with "Dashboard" highlighted, followed by "buildPC" and "sa_stars_qbl_2_int Nightly Build". On the left, there's a sidebar with links: "Project Report", "Project Status", "Latest Build", and "View All Builds". Below these links is a "Recent Builds" section with a list of builds from 2012-02-29 to 2012-03-14, including their timestamps and status (Failed or Success). The main content area shows the "Current Status for sa_stars_qbl_2_int Nightly Build". It lists three tasks: "ClearCase: CheckForModifications", "Pre-build tasks", and "ExecutableTask", each with its name, status, time started, and time completed.

CruiseControl.NET
CONTINUOUS INTEGRATION SERVER

Dashboard > buildPC > sa_stars_qbl_2_int Nightly Build

[Project Report](#)
[Project Status](#)
[Latest Build](#)
[View All Builds](#)

Recent Builds

2012-03-14 22:20:20 (Failed)
2012-03-14 00:14:44 (124)
2012-03-13 00:11:39 (123)
2012-03-09 22:20:00 (Failed)
2012-03-08 00:07:48 (122)
2012-03-06 22:20:00 (121)
2012-03-06 00:08:17 (Failed)
2012-03-03 00:06:46 (120)
2012-03-02 00:07:47 (119)
2012-02-29 22:20:00 (118)

[Show All](#)

Current Status for sa_stars_qbl_2_int Nightly Build

sa_stars_qbl_2_int Nightly Build

✓ **ClearCase: CheckForModifications**

Name:	ClearCase: CheckForModifications
Status:	CompletedSuccess
Time Started:	Thu Mar 15 2012 22:20:00 GMT+0100 (W. Europe Standard Time)
Time Completed:	Thu Mar 15 2012 22:21:42 GMT+0100 (W. Europe Standard Time)

✓ **Pre-build tasks**

Name:	Pre-build tasks
Status:	CompletedSuccess
Time Started:	Thu Mar 15 2012 22:21:42 GMT+0100 (W. Europe Standard Time)
Time Completed:	Thu Mar 15 2012 22:21:53 GMT+0100 (W. Europe Standard Time)

✓ **ExecutableTask**

Name:	ExecutableTask
Status:	CompletedSuccess

- Struggles in integration – improvise!
- Expensive machine time

Future improvements

- Twist
 - Will replace Replay tests
 - Will replace manual weekly validation test
 - Will help decrease alpha test
- TICS (static code checking)
- Extending CODED UI Tests
- Extending Unit Tests
- **Bet on the correct horse in the different levels of the V Model!**





Company Secret



ASML